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(54) Title: ANTI-STATIC, NON-SPARKING COATINGS FOR EXPLOSIVE ENVIRONMENTS

(57) Abstract

There is disclosed an anti-static, non-sparking coating that can be applied to various components such that the components may be safely used in explosive environments.

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INTERNATIONAL PATENT APPLICATION

Entitled

ANTI-STATIC, NON-SPARKING COATINGS FOR EXPLOSIVE ENVIRONMENTS

Field of the Invention

This invention generally relates to a coating, and a method of producing a coating, that can be used in explosive environments. More specifically, this invention relates to an anti-static, non-sparking coating that can be applied to various components such that the components may be safely used in corrosive and explosive environments.

Background of the Invention

In the chemical, petrochemical, and refinery operations business, a myriad of components are used for testing, inspecting, cleaning, and operating various process vessels, storage tanks, reactor vessels, and the like. The metal structure of theses components constitutes a conducting path allowing the flow of electrostatic charges generated by the movement of gases, vapors, dusts, or liquids contained in the vessels and tanks. These components, however, have non-conducting elements that resist this flow by encouraging the accumulation of electrostatic charges on their surfaces. The

same is true of metal surfaces coated with polymer based coatings, since the polymer acts as a very thin non-conducting element. These polymers, however, can withstand the harshest chemical environments, and are needed because the components on which they are applied would otherwise corrode, degrade, or become inoperable. While these coatings are suitable for corrosive environments, these coatings are subject to static buildup, which precludes their use in explosive environments.

In fact, several standards and regulations have been promulgated to provide guidelines as to acceptable electrostatic levels for a variety of materials or enclosures. One such standard is European Standard EN 50014, Section 7.3.2. This standard requires that enclosures shall be so designed that under normal conditions of use, maintenance, and cleaning, danger of ignition due to electrostatic charges are avoided. This requirement can be satisfied by either of the following: **(a)** by suitable selection of the material so that the insulation resistance of the enclosure does not exceed 1 GΩ at 23±2°C and 50±5% relative humidity; **(b)** by limitation of the surface area of plastics enclosures or plastics parts of enclosure (for example, for Group IIA and IIB apparatus to a maximum of 100 cm^2 except that this may be increased to a maximum of 400 cm^2 if the exposed areas of plastics are surrounded by conductive earth-grounded frames); or **(c)** by virtue of the size, shape, and lay-out, or other protective methods, such that dangerous electrostatic charges are not likely to occur.

Because of these types of regulatory standards, there is a need for a new coating that is anti-static and non-sparking that can be applied to various components,

such that the components may be safely used in corrosive and explosive environments.

Summary of the Invention

The present invention is directed to an anti-static, non-sparking coating that can be applied to various components such that the components may be safely used in corrosive and explosive environments.

The foregoing has outlined rather broadly the features and technical advantages of the present invention so that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiment disclosed may be readily used as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

Detailed Description of the Invention

Many of the components used for testing, inspecting, cleaning, and operating various process vessels, storage tanks, reactor vessels, and the like are coated with chemically-resistant polymers such as fluoropolymers. Fluorine-containing polymers,

or fluoropolymers, are an important class of polymers and include for example, fluoroelastomers and fluoroplastics. Within this class are polymers of high thermal stability and usefulness at high temperatures, and extreme toughness and flexibility at very low temperatures. Many of these polymers are almost totally insoluble in a wide variety of organic solvents. See, for example F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed., pp 398-403, John Wiley & Sons, New York (1984). These polymers, however, cannot be used in explosive environments because they encourage the accumulation of electrostatic charges on the surfaces of the coated component.

Ideally, coatings that are used in explosive environments would have low resistivities to ward off electrostatic charges. By way of explanation, a "perfect" conductor would have zero resistivity and a "perfect" insulator an infinite resistivity. Metals (such as copper and gold), alloys (such as manganin and nichrome), and semiconductors (such as carbon or germanium) have the lowest resistivities and are the best conductors. The resistivities of insulators (such as glass, Teflon, and wood) exceed those of metals by a factor of the order of 10^{22}.

A number of polymer based coatings used in caustic chemical environments were tested prior to modification, and all failed the anti-static tests with resistivities greater than 85 GΩ's. Exposed surfaces greater than 100 cm^2 must have a resistivity less than 1 GΩ to qualify as static conductive under the certification standards. Carbon powder was added to the coatings to increase the conductivity. Carbon percentages from about 10% to about 50% passed the certification testing with

resistivities less than 1 GΩ. The carbon powder enhances the ability of the polymer coating to conduct static electricity away from the surface, preventing sparking. Components using this type of material can now be coated for chemical protection and used within potentially explosive environments.

EXAMPLE

The initial results of the tests ran on the Halar fluoropolymer coating on a submergible vehicle that can be used in storage tanks measured 8.5×10^{10} Ω and the maximum allowed was 1.0×10^{10} Ω. Halar is a trademark of Ausimont of Morristown, New Jersey for ethylene-chlorotrifluoroethylene (ECTFE). Halar coatings have favorable characteristics that include: resistance to strong acids, such as sulfuric, nitric, hydrochloric, and hydrofluoric, over a wide temperature range; the ability to handle powder bleaching agents, such as sodium hypochlorite; resistance to strong bases, such as sodium hydroxide and potassium hydroxide; and resistance to strong polar solvents, such as n-methyl pyrrolidone and dimethyl formamide, that would dissolve other polymers. In fact, Halar fluoropolymers are advertised as incapable of being dissolved by any known solvent up to 300°F. Moreover, the e xtruded, molded, and powder coated surfaces of Halar fluoropolymer exhibit extraordinary smoothness. Despite these favorable attributes, Halar polymers cannot be certified for explosive environments.

A series of five sample coatings were developed with graphite being added to the fluoropolymer coating in percentages ranging from about 10% to about 50%. The graphite was added to the coating to increase its conductivity and resistance to building up static. The same insulation resistance tests were run on each sample and the results were all well below the 1.0×10^{10} required. In the preferred embodiment, the fluoropolymer coating used on the submergible vehicle has 10% graphite added to it.

Accordingly, the present invention describes a method and materials for coating components for use in hazardous locations that are capable of meeting Class I Division 1 certification standards that are required for safe use within an explosive environment, as specified in the National Electric Code.

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions, and alterations could be made herein without departing from the spirit and scope of the invention as defined by the appended claims.

Claims of the Invention

What is claimed is:

1. An anti-static, non-sparking coating comprising:

a chemically resistant polymer, said polymer having a high resistivity; and

a conductor material , said material having a low resistivity.

2. The coating of Claim 1 wherein said polymer is a fluoropolymer.

3. The coating of Claim 1 wherein said conductor material is carbon powder.

4. An anti-static, non-sparking coating comprising:

from about 50% to about 90% by weight of a chemically resistant polymer; and

from about 10% to about 50% by weight of a conductor material.

5. The coating of Claim 4 wherein said polymer is a fluoropolymer.

6. The coating of Claim 4 wherein said conductor material is carbon powder.

7. A method for priming a component to provide chemically resistant and anti-static, non-sparking properties, wherein said component can be used in explosive environments, said method comprising:

coating the component with an effective amount of a chemically resistant and anti-static, non-sparking composition; and

drying said coating on said component, wherein said coating comprises:

from about 50% to about 90% by weight of a chemically resistant polymer; and

from about 10% to about 50% by weight of a conductor material.

8. The method of Claim 7 wherein said polymer is a fluoropolymer.

9. The method of Claim 7 wherein said conductor material is carbon powder.